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PROGRESS REPORT NO. 1

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INTRODUCTION

**This is the first progress report of Research Order No. 22,
Contract No. RD-53-SA.**

The objective of this development program is the design and construction of two identical microphone jamming transmitters. An investigation of the problem of microphone jamming was conducted under Research Order No. 14. Reference is made to the report of that program which describes the basic theory and background information. Essentially, jamming is accomplished by providing a high energy, noise modulated, radio frequency field. The R. F. energy induces an R. F. voltage in the microphone connecting leads. This signal is demodulated by any non-linearity in the surveillance audio amplifier. Sufficient non-linearity is present in all amplifiers to provide this demodulating action. After demodulation the noise signal provides masking or jamming of the normal audio signal.

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STATEMENT OF THE PROBLEM

The preliminary investigation indicated that a minimum R. F. power of 100 watts was desirable and that the amplitude of the modulation should be as close to 100 percent as possible.

The following are the requirements for the transmitter system:

- (a) The transmitter package shall consist of two standard suitcases,
- (b) the power output shall be in excess of 100 watts,
- (c) the modulation shall be white noise and essentially 100 percent, type A3 (amplitude modulation),
- (d) the output stage shall be capable of coupling to a wide range of load impedances to accommodate the expected field conditions,
- (e) operation shall be simple, straight-forward, and without hazard to the operator, to allow operation by untrained personnel,
- (f) the unit shall be capable of operation from 117 or 234 volt (nominal), 50 to 60 cycle power lines,

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- (g) the packaging shall be as strong as possible, consistent with the other requirements, to allow field use of the equipment,
- (h) the total weight of the unit shall be a minimum, for portable use, and this weight shall be approximately evenly distributed between the two suitcases.

The major problem is that of providing a maximum power output within the weight and size limitations. The design objectives are that the suitcases should be standard 26 inch pullman cases and that the unit weight per case should be 30 pounds. This problem is complicated by the requirement that the units be strong enough to withstand field use. Commercial amateur transmitters, with comparatively weak sheet metal cases, weight between 90 and 150 pounds for the required power output.

APPROACH TO THE PROBLEM

In order to meet the requirements of weight and size, the following criteria were used in designing the transmitter:

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- (a) the circuits used should require the minimum number of components and tubes,
- (b) the components should be those of minimum size and weight that will perform satisfactorily,
- (c) where standard components are not satisfactory, due to size or weight, special components should be designed and constructed, if possible,
- (d) the mechanical supporting structure should make use of designs requiring minimum material and the material should have a high strength-to-weight ratio.

In general, the circuits and components used should be designed on a balanced basis, so that each item is only as large and heavy as it must be for the work it does.

The requirement that the unit be capable of operation by untrained personnel dictates the following criteria:

- (a) that there should be a minimum of variable controls with as many as possible preset,

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- (b) that the equipment be stable in operation to provide for a minimum of readjustment during use.
- (c) that the components be adequately shielded to eliminate any shock hazard.

DETAILED WORK

A survey was made of available tubes and suitable circuits for use as R. F. oscillators, amplifiers, power output stages, noise generators, noise amplifiers and modulators. The factors considered in the survey were size, weight, power output, efficiency, and simplicity of operation.

A number of modulator and R. F. power output stages were designed with matched components. That is, all components were designed to operate at the same percentage of maximum ratings, to provide, as much as possible, a balanced system of minimum weight. For each of these tentative circuits a complete power supply, including special

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transformers, was designed. This resulted in several complete component designs for the power supplies, modulator stage, and R.F. output stage. Since these represent the major weight in components, the total weight was then estimated, including the oscillator and driver stages, the noise generator and amplifiers, and the suitcase and mechanical supporting structure. The system that had an estimated weight closest to the design criteria, while still providing a power output well in excess of 100 watts, was chosen.

The preliminary design for the supporting structure consists of a units frame of aluminum channel. This will be fastened to the suitcase handle, the snap locks, and the ball feet on the hinge side of the suitcase. In this way, the weight of the equipment will be carried directly through the suitcase handle and not transmitted through the body of the case. At the same time, the aluminum frame will tie the hinge and lock sides of the case together to provide additional rigidity and to prevent distortion.

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The circuitry was divided to provide approximately equal weight in the two cases comprising the transmitter. One case contains the R. F. oscillator, driver, and power output stages. In addition a low voltage power supply, bias supply, and filament transformer were included.

The second case contains the noise generator, noise amplifiers and modulator stages. The high voltage power supply is included in this case.

A sketch of the basic circuit for the first suitcase is shown in Figure 1. A 6C4 tube is used as a crystal oscillator. This is followed by a 6L6 driver stage and an 813 power output stage. The plate circuit of the output stage is a pi type network, designed to match a wide range of antenna load impedances.

A circuit sketch of the second case is shown in Figure 2. A 2D21 gas thyatron is used as a noise generator. The 12AX7 dual triode amplifies the noise signal. A dual resistive-capacitive filter inserted

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between the 12AX7 sections limits the noise bandwidth to the 200 to 6000 cycles per second range. This is followed by a 6C4 driver stage and a pair of 6146 tubes in the modulator stage.

The power supplies are conventional with the exception of the dual primaries on the transformers which allow operation on 107 to 127 volts (parallel connection) or on 214 to 254 volts (series connections).

Since the original investigation (Research Order No. 14) indicated no difference in operation for frequencies from 2 to 30 megacycles the frequency of operation was arbitrarily chosen as 3 megacycles. A crystal oscillator was used after tests on a number of variable frequency oscillators, because it provided a stability that eliminated the need for retuning of the output stage during extended operating periods. The 6L6 driver stage acts as a buffer between the oscillator and output stages and is capable of delivering ample driving power to the 813, thus insuring maximum output under all conditions.

The pi type output network was chosen because it provides an optimum impedance match for resistive or reactive loads with amplitudes from

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approximately 30 to 2000 ohms. In addition, it is simple to operate and adjust.

The tuned circuit variation is sufficient to allow the use of crystals from 2.7 to 3.3 megacycles per second.

A complete breadboard model of the transmitter was constructed and tested. Preliminary data indicates an average power output in excess of 150 watts at 90% modulation using a 200 watt tungsten bulb as a load.

CONCLUSIONS AND FUTURE WORK

The preliminary circuit design will with minor modifications, be suitable for the final unit.

The mechanical design for the final assembly will be completed and the final units fabricated, wired, and tested.

Tests will be conducted with various antennas to determine optimum lengths and connections for maximum radiation efficiency.

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The final transmitter unit will be contained in two 26 inch suitcases, will be complete with line cord, antenna and interconnecting cable, and will provide approximately 150 watts of noise modulated R. F. power.

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